The benefits derived from warnings issued in connection with this storm were marked. The fishing fleets were on the point of departure for the banks, but the flags caused them to remain. Numerous excursion parties had chartered sloops and other craft and were ready to sail on cruises lasting over the approaching holiday, and they too remained in port. Extra moorings were placed by many of the craft at anchor in the bay, and only those thus safeguarded escaped being thrown on the beach. The wind was so severe that signals and halyards were carried away at the display stations, and the Spreckels Brothers Commercial Companies' bunkers were carried away after twelve hours strain.

—*Alexander G. McAdie, Professor of Meteorology.*

PORTLAND, OREG., FORECAST DISTRICT.†
[Oregon, Washington, and Idaho.]

The month was about as stormy as usual altho no noteworthy marine casualties occurred. The principal storm period was from the 12th to 20th, and during this period gales of 60 to 70 miles an hour were of frequent occurrence along the coast, and the winds in the Puget Sound country were at times as high as 40 or more miles an hour. Another stormy period occurred later in the month. Warnings of all gales were issued in time to be of benefit to marine interests on the north Pacific coast. On the morning of the 8th a cold wave threatened to overspread the eastern portion of the district and warnings for the expected change were issued. The appearance in the afternoon of a low-pressure area off the Washington coast prevented a sinking of temperature to a point to justify the warnings and they were accordingly canceled in the evening. Altho rivers were nearly all at stages above the normal no floods occurred nor were there any damaging washouts.—*E. A. Beals, District Forecaster.*

## RIVERS AND FLOODS.

### THE FLOODS OF JANUARY AND FEBRUARY, 1909, IN THE SACRAMENTO VALLEY OF CALIFORNIA.

In the State of California the month of January, 1909, was characterized by heavy and almost continuous precipitation, the total amount ranging from 7 to 10 inches in the great valleys to much greater amounts at the higher elevations. At Kennett, near the mouth of the Pitt River, the precipitation for the month reached the astonishing total of 54.08 inches, probably the greatest precipitation ever recorded in a single month in the entire United States. This was followed by 24.30 inches during February. At Colgate, on the Yuba River, the total amount for the month was 29.10 inches, followed by 11.61 inches in February. There was also a considerable quantity of snow over the Sierras. The result, of course, was a great and very destructive flood. There was a moderate flood during the first decade of January, but the great flood did not begin until the 14th, when a rapid rise set in over the entire Sacramento River. There was an intermission during the last week of the month, followed by more heavy rains and another flood during the first week of February, and the last of the flood waters were just passing into Suisun Bay at the end of the month.

The flood did not differ materially in character from the one of March, 1907, except that the latter one was the more destructive of the two, and the losses and damage were such as usually result from great floods. At Red Bluff and Sacramento the crest stages of 30.5 feet on February 3, and of 29.6 feet on January 17, respectively, were the highest of record, while the crest stage of 23.9 feet on January 16 in the Yuba River at Marysville was 0.6 foot above the previous high-water record of March 19, 1907.

About 150,000 acres of land were overflowed, but, as the flood occurred during the winter season, the crop loss was reduced to a minimum. Efforts were made to secure reliable estimates of the losses and damage, and from these it appears that the amounts were approximately as follows:

| | |
|---|---|
| Property exclusive of crops | $1,715,000 |
| Crops | 611,000 |
| Erosion of farm lands | 76,000 |
| Suspension of business | 100,000 |
| Total | $2,502,000 |

The value of property saved thru the warnings of the Weather Bureau was about $300,000, comprising practically everything that could be moved.

The warnings issued by the Weather Bureau in connection with this flood were timely and accurate, and many testimonials relative to their high character and value have been received. They were instrumental in saving many lives as well as a large amount of property, and have demonstrated the fact that the River and Flood Service is an important adjunct to the further development of the great valley of the State of California.

GENERAL REMARKS.

High temperatures over the Ohio Valley watershed on February 22 and 23, combined with heavy rains on the latter date, resulted in a general, tho not severe, flood in the Ohio River and its western tributaries. It was most marked from Cincinnati, Ohio, westward, and at the end of the month the crest had just past Evansville, Ind., with a stage of 42.9 feet, 7.9 feet above the flood stage. The flood stage of 40 feet at Paducah, Ky., was exceeded by 1 foot at the same time.

At Cincinnati the crest stage was 54.6 feet, 4.6 feet above the flood stage, and at Louisville, Ky., 33 feet, 5 feet above the flood stage.

The interior rivers of the States of Ohio, Indiana, and Illinois were also in moderate flood, but no serious damage was done. Warnings were issued whenever necessary, and they were unusually effective in the State of Ohio. The total losses north of the Ohio River were probably not over $25,000, while the value of property saved thru the warnings of the Weather Bureau was at least ten times as much.

In the State of Kentucky, however, conditions were much more serious. The floods extended over the entire State, and all streams were out of their banks. At Louisville 5 inches of rain fell in twenty-four hours, and the property losses amounted to at least $300,000. In the interior of the State every industry suffered, and thousands of residents in the bottoms and lowlands were made homeless for some time. It is estimated that the total losses in the State of Kentucky amounted to several millions of dollars, the heaviest of which fell upon the agricultural and lumber interests.

Heavy rains with high temperatures on the 19th caused a severe freshet in the Hudson River below the mouth of the Mohawk River, and stages from 6 to 8.5 feet above the flood stages were experienced at Troy and Albany, N. Y., on the 21st. The abnormally high stage of 22.5 feet at Troy was in part caused by back water from the ice gorge, 2½ miles below Albany. Warnings for the freshet were issued on the morning of the 20th, and little or no avoidable damage was reported. The total losses were about $225,000, of which $25,000 was due to enforced suspension of business. There was no damage to crops or farm lands, and the value of property saved by the warnings was about $100,000.

There was only a moderate freshet in the upper Susquehanna and upper Delaware rivers, and owing to timely warnings the resulting damage was inconsequential.

Moderate floods also occurred in the south during the second decade of the month, and the warnings therefor were of especial value to the cattle interests. In the Ocmulgee and Altamaha rivers the tide was a distinct benefit as it permitted the resumption of navigation after a suspension of about three months. In the southern portion of the State of Mississippi there were losses amounting to about $12,000, divided as follows:

| | |
|---|---|
| Property, exclusive of crops | $2,000 |
| Crops | 4,000 |
| Erosion of farm lands | 1,000 |
| Suspension of business | 5,000 |
| Total | $12,000 |

The value of property saved thru the warnings was $10,000.

The lower Missouri and upper Mississippi rivers were at moderate stages thruout the month, while the annual rise in the lower Mississippi River set in at New Madrid, Mo., on the 9th, reaching the flood stage of 34 feet on the 27th.

ICE.

The Missouri River opened at Omaha, Nebr., on the 27th, but remained closed above. Below Omaha it was opened during the greater portion of the month, and no ice of consequence was observed below the mouth of the Osage River. There was but little change in the Mississippi River, the ice continuing solid as a rule above Davenport, Iowa. No ice was observed below New Madrid, Mo.

There was some increase in the thickness of the ice in the upper Missouri River, with a maximum of 32 inches at Bismarck, N. Dak., an increase of 8 inches during the month. There was but little change in the upper Mississippi River, while in northern New England there was a little more ice than during January, 1909.

The highest and lowest water, mean stage, and monthly range at 198 river stations are given in Table IV. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

## SPECIAL ARTICLES, NOTES, AND EXTRACTS.

### NOTES FROM THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Librarian.

THE ISOTHERMAL LAYER OVER EQUATORIAL AFRICA.

The most interesting piece of news that has come to us from meteorological circles abroad since the last installment of these notes was written is the announcement that the recent German aerological expedition to East Africa (See MONTHLY WEATHER REVIEW, December 1908, p. 422) found the isothermal or relatively warm stratum of the high atmosphere over Victoria Nyanza. This and other results of the expedition are published in the January, 1909, number of the Quarterly Journal of the Royal Meteorological Society in a communication from Doctor Assmann, director of the Royal Prussian Aeronautical Observatory at Lindenberg, dated January 31, 1909.

The isothermal layer was reached by two ascents of sounding-balloons, at altitudes of 65,000 and 56,000 feet( 19,800 and 17,000 meters). It will be remembered that the *Otaria* expedition, sent out by Messrs. Rotch and Teisserenc de Bort, failed to reach this layer over the equatorial regions of the Atlantic, tho some of their balloons rose to nearly 50,000 feet; but Rotch and others have confidently predicted that it would be found in equatorial regions as soon as balloons could be raised to a sufficient altitude. We may now safely conclude that this phenomenon is common to all latitudes, having its greatest elevation in the neighborhood of the equator and its least over the poles.

Especially remarkable, says Doctor Assmann, is the great average decrease of temperature with altitude found over Lake Victoria; the lowest temperature encountered at 65,000 feet (19,800 meters), was —119°F. (—84°C.), with a temperature at the ground (3,800 feet, or 1,150 meters, above sea level) of 79°F. (26°C.). The variability of the temperature at high levels is enormous in equatorial, as well as in higher latitudes. Two ascents gave readings at 56,000 feet (17,000 meters) of —105°F. (—76°C.) and —62°F. (—52°C.), respectively.

In addition to the ascents of sounding-balloons a number of small pilot-balloons were sent up to great altitudes to explore the direction and velocity of the upper air currents, and these showed the presence of an uppermost current of air blowing nearly from due *west*, and flowing above the regular easterly current of the equatorial region. A similar discovery was made some time ago at Cairo, Egypt, by B. F. E. Keeling, as recorded in these notes last June.

The ascents over Lake Victoria were made from a low-powered launch, and would have yielded better results had a faster boat been available. It is stated that with a vessel having a speed of some 12 miles an hour this lake is the best place in the world for sounding-balloon ascents, because the winds are generally feeble enough to permit the recovery of all the balloons sent up.

THE METEOROLOGY OF ABYSSINIA AND THE NILE FLOOD.[1]

Another African expedition of much interest was that sent to Addis Abbaba, the capital of Abyssinia, in May, 1907, by the meteorological service of Egypt, to study the meteorological conditions controlling the Nile flood. As pointed out in these notes some years ago,[2] the Nile flood is a faithful index to the rainfall of Abyssinia, since the Blue Nile, when in flood, holds back the water of the White Nile, so that the contribution of the latter to the flood is negligible. Thus the meteorology of Abyssinia, the country in which the Blue Nile takes its rise, is a matter of great interest to the people of Egypt.

The chief rainfall was found to be associated with thunderstorms. Nevertheless, tho accounts from all parts of Abyssinia agree that the intensity of electrical phenomena was much greater in 1907 than it had been for years, a condition favoring heavy rainfall, the latter was actually much lighter than usual—as shown by the very low flood of that year. This contradiction is explained by the statement that the rain-bearing winds were much weaker than usual. While the atmospheric circulation in this part of the world calls for much further investigation, the author of the memoir under discussion states confidently that the moisture precipitated over Abyssinia comes all the way across the African Continent from the South Atlantic Ocean. The writer adds:

> This theory bears on only one factor of the rainfall, the supply of moisture. The velocity of the current would still be in great part determined by the isobaric gradients of the great monsoon depression, and finally the convectional ascensional movement would probably require separate discussion.

A much more elaborate report on the results of this expedition is in preparation.

THE WEATHER SERVICE OF THE FRANKFORT AERONAUTICAL EXPOSITION.

Dr. F. Linke announces in Illustrierte aeronautische Mitteilungen that the Geophysical Institute of the Physical Society of Frankfort-on-the-Main has undertaken to organize a special weather service for the Frankfort Aeronautical Exposition (July–October, 1909). Telegrams from the whole of Europe will be received twice a day and two weather maps drawn. Observations from the higher strata of the atmosphere will also be obtained. Of course the conditions over Frankfort will be of first importance. An aerological station will be established in Frankfort, where once or twice a day soundings of the lower layers of the atmosphere will be made by means of kites or captive balloons with self-registering instruments.

[1] Craig, J. I. A meteorological expedition to Addis Abbaba, in 1907. Alexandria, 1909. (Reprinted from the "Cairo scientific journal," No. 27, 1908.)

[2] Monthly Weather Review, May, 1906, 34 :228.